



THE UNIVERSITY OF ARIZONA
COLLEGE OF MEDICINE TUCSON

Pediatrics



Walking People Back from the Vaccine Cliff: the Ins and Outs of Vaccines and How to Combat the Myths and Misinformation

Nathan Price, MD FAAP
Associate Professor of Pediatrics
Division of Pediatric Infectious Diseases
University of Arizona College of Medicine
Banner UMC-Tucson

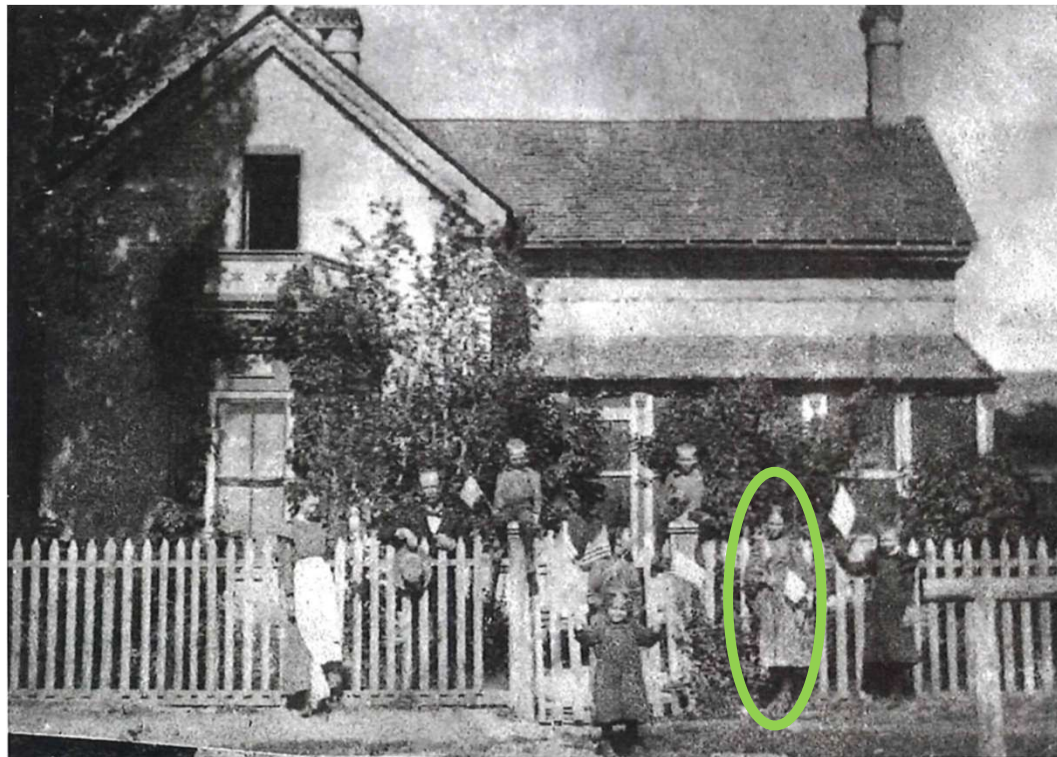
Disclosures

- I have no conflicts of interest to disclose

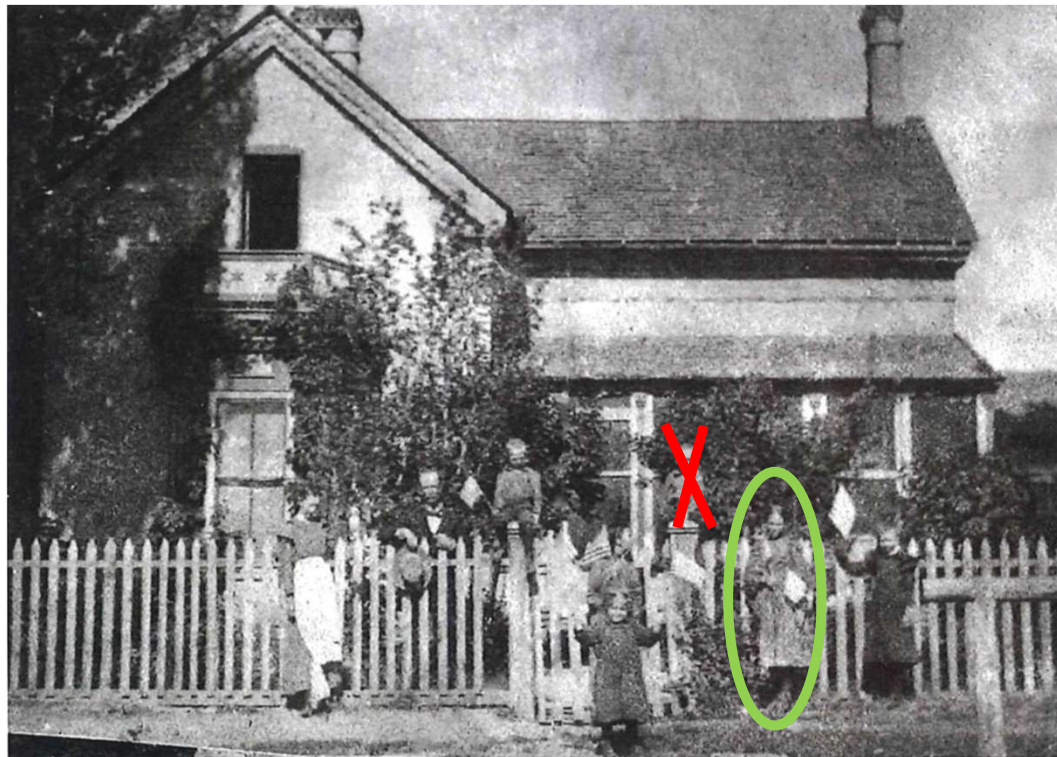
Objectives

- Describe the changing epidemiology of vaccine preventable illnesses
- Describe the safety and efficacy of vaccines
- Refute common vaccine myths

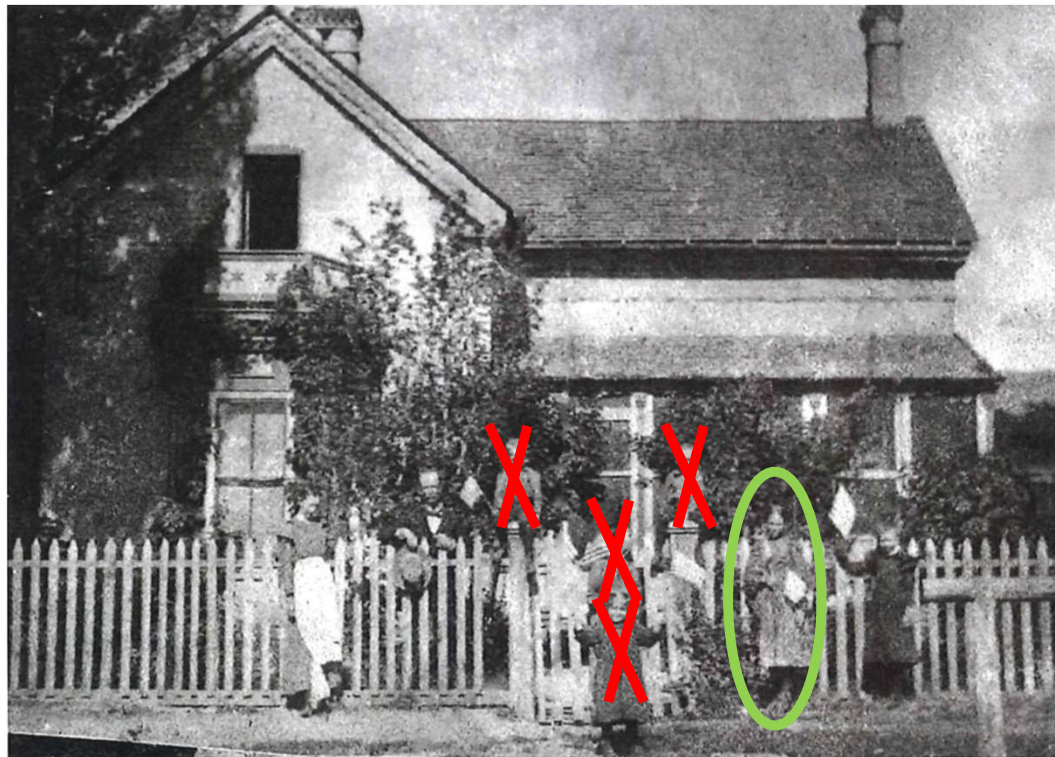
Life before vaccines: July 4th, 1898: Agnes Jones with her family



July 1902: Diphtheria Epidemic



July 1902: Diphtheria Epidemic



George: age 12

Daniel: age 10

Louise: age 7

Evan: age 3

Margaret Lloyd: age
9

1934 El Paso, TX



Mary Ardelle

1934 El Paso, TX



Died at age 3 from
measles encephalitis

Mary Ardelle

Vaccine Success

- CDC estimates vaccines have prevented in the U.S 1994-2023:
 - 508 million illnesses
 - 32 million hospitalizations
 - **1.29 million deaths (and there ARE NOT 1.29 million vaccine deaths!!!!!!)**
 - 60 measles deaths worldwide
 - 2.6 millions deaths annually prior to vaccination
 - \$540 billion in direct costs
 - \$2.7 trillion in societal costs
- Smallpox eradicated in 1977
 - Only human infectious disease eradicated
 - Mortality of up to 35%
- Polio eradicated from the U.S. in 1979
- Marked reduction in bacterial meningitis cases
- Chickenpox

Reduction in Morbidity and Mortality of Some Vaccine-Preventable Diseases in the US

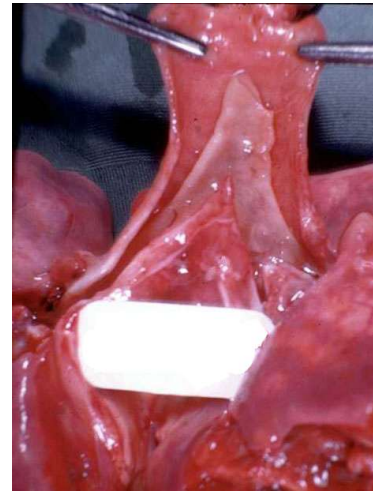
Disease	Maximum No. of Cases (y)	Cases in 2019	% Decrease
Diphtheria	206,939 (1921)	2	>99
Pertussis	265,269 (1934)	18,617	93
Tetanus	1314 (1922–1926)	26	98
Poliomyelitis, paralytic	21,269 (1952)	0	100
Measles	894,134 (1941)	1275	>99
Mumps	152,209 (1968)	3780	98
Rubella	57,686 (1969)	6	>99
Congenital rubella syndrome	20,000 (1964–1965)	1	>99
<i>Haemophilus influenzae</i> type b (<5 y)	20,000 (before 1987)	18	>99
Invasive pneumococcal disease (<5 y)	15,933 (2000)	1115	93
Hepatitis B	21,102 (1990)	3544	83
Varicella	158,364 (1992)	8297	95

Corynebacterium diphtheriae

- Exotoxin mediated bacterial disease
- Mortality of up to 50% in the 1800s
 - Modern mortality rate of 5-10% with antitoxin use
 - 60,000 deaths worldwide annually in the 1970s
- Droplet transmission
 - 6-7 secondary cases
 - Contagious for 2-4 weeks without antibiotics
 - Some carriers shed for 6 months or more

Diphtheria

- Pseudomembranes
 - Can obstruct airways
 - Early use of tracheotomy and endotracheal intubation
- Lymphadenopathy and edema: bull neck
- Toxin
 - Myocarditis
 - Early (days) and late (weeks) presentations
 - Paralysis (5-6 weeks later): eyes, limbs, diaphragm
 - Renal failure
- Cutaneous infection possible



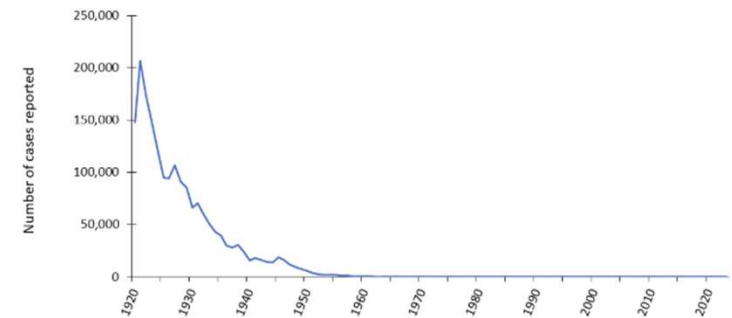
Diphtheria Treatment

- Equine derived antitoxin
 - Not commercially available, high rate of anaphylaxis
- Antibiotics to stop replication/prevent transmission
 - Erythromycin, penicillin, quinolones, etc
- Still need vaccination if you survive since toxin is so potent it doesn't always confer immunity

Diphtheria Vaccine

- Toxoid vaccine developed in the 1920's
 - Combo vaccine DTP became part of the universal childhood vaccine program in the 1940's
- Series is 95% effective in preventing disease
- Need booster every 10 years
- Last outbreak in AZ was in the 1970s on the Navajo reservation
 - At least 46 cases
 - 85% needed hospitalization, 2 deaths
 - Most unvaccinated or partially vaccinated
- 14 cases in the US from 1996-2008
 - Last case of respiratory infection was 1997

Reported Diphtheria, 1920–2023, NNDSS, United States



SOURCE: CDC, National Notifiable Diseases Surveillance System

Diphtheria Resurgence: Former USSR Countries

- Rates of diphtheria fell from >750,000 cases/yr to 199 cases after universal vaccination in the 1950's
- 1990s fall of the Soviet Union: vaccination rates drop to as low as 60%
 - Increased anti government sentiment
 - Increased anti-vaccine sentiment and fear
 - Lack of access to vaccine in former Soviet republics
 - Increase crowding, poverty
 - Waning immunity in adults
 - Dropped school vaccine dose
 - Lower potency vaccine was being used
- Outbreak occurs: 170,000 cases and 5000 deaths
 - Most were adults, but children were affected as well

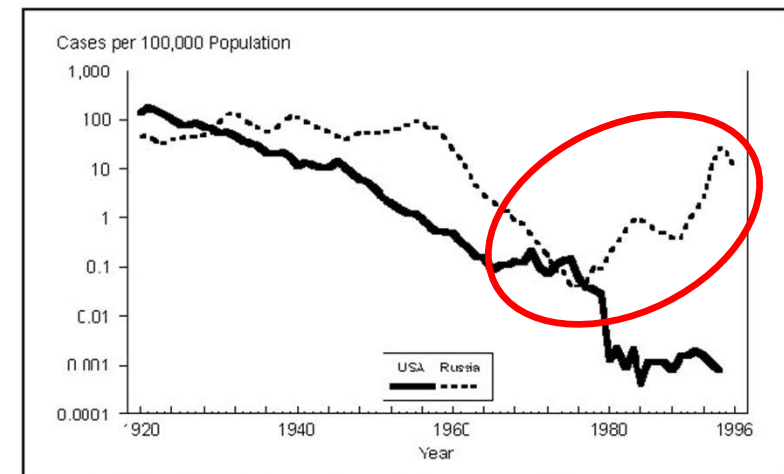


Figure 2. Diphtheria Incidence—United States and Russian Federation, 1920–1996.

Diphtheria Resurgence: Former USSR Countries

- Instituted widespread vaccination and the outbreak was stopped
 - Higher potency vaccine
 - Adult boosters
 - Added back the school age dose

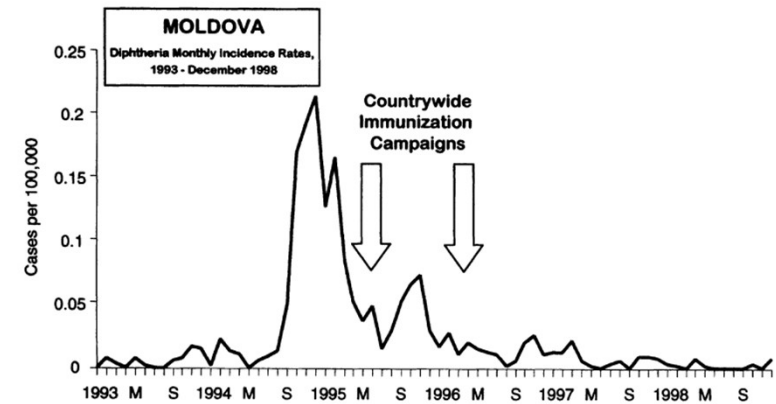


Figure 3. Reported diphtheria incidence by month, Moldova, 1993–1998

Diphtheria is Still Out There

- 14% unvaccinated or incompletely vaccinated worldwide
 - Increasing cases over time
- Africa outbreak 2013-2023
 - Vaccination rate of 70-83%
 - 29 million children didn't get 1st dose of DTP from 2019-2022
 - 41,154 cases, most were unvaccinated

Diphtheria Vaccine Rates in the US

- Need 85-90% to prevent outbreaks
- AAP vaccination data (4 doses in 24m old children)
 - AZ 75%
 - Our neighbors: CA 67%, NV 69%, UT 85%, NM 70%
 - US 79%
- Death is only a plane ride away
 - Or a road trip.....

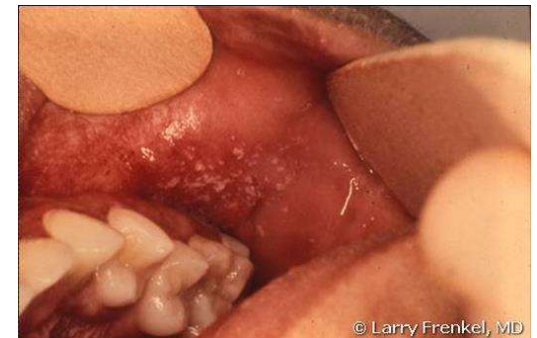
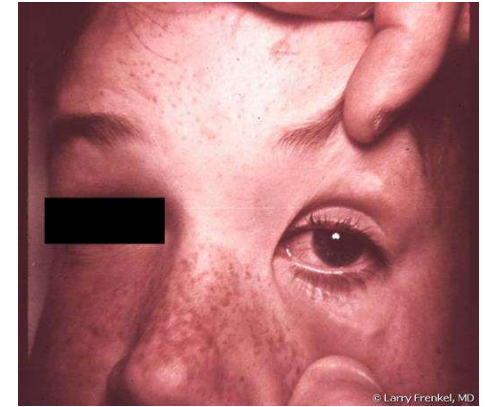
Recent Patient

- Almost 2 y/o unimmunized boy shows up with fever to 104, and rash that started on his face and moved to the rest of the body. He has runny nose, and has been coughing and has red eyes. He looks miserable. What does this sound like?
 - What is the very first thing you should do?
 - Put a simple mask on the patient and caregivers
 - What else?
 - Keep him away from other patients
 - Healthcare providers wear N95 (or respirator)
 - Use a negative pressure room if you have it
 - Call Infection prevention (if you have it)
 - Call the Health Department



Measles

- Prodrome (usually last 2-4 days, starts 7-21 days after exposure)
 - Increasing fever up to 105 over 2-4 days
 - 3 C's: cough, coryza, conjunctivitis
 - Cough, often described as brassy
 - Coryza: runny nose/congestion
 - Conjunctivitis
 - Koplik spots 1-2 days prior to rash
 - Bluish and/or white specks on a bright red mucosal surface
 - Usually disappear by the time the rash appears



Measles

- Rash
 - Starts 2-4 days after onset of prodrome/fever
 - Begins at the head and moves towards the feet
 - Spares palms and soles
 - Starts to fade after 4 days
- Fever often high grade, usually resolves by day 3 of the rash
 - Prolonged fever suggests bacterial superinfection
- Other symptoms/findings: pharyngitis, laryngitis, diarrhea, generalized adenopathy, splenomegaly, abdominal pain



Other Measles Presentations

- Increased severity in immune compromised patients
- Modified severity
 - Breakthrough infection despite vaccination
 - Immune globulin
 - Transplacental antibody (infants <9m old)

Measles: Why Do We Care?



- 1-3/1000 die from complications of measles
 - Encephalitis, pneumonia, DIC, etc
 - 1/1000 develop encephalitis
 - 20-40% have permanent sequelae
- 1/20 develop measles pneumonia
 - Common cause of hospitalization, especially in young children
- 38% of children <5 years of age in the US require hospitalization due to severity of symptoms

Measles: Why Do We Care?

- Bacterial superinfection
 - Pneumonia, otitis media, adenopathy, etc
- Pregnancy related complications
 - Spontaneous abortion, stillbirth, premature delivery and low birth weight
- Increased risk of blindness and death with Vitamin A deficiency

Measles: Why Do We Care?

- 4-11/100,000 Subacute Sclerosis Pan Encephalitis (SSPE)
 - Progressive, universally fatal neurologic condition that occurs years after recovering from initial infection
- Immune amnesia
 - Measles infection causes you to lose immunity to other infections
 - Infects B- and T-cells that are cleared by the immune system
 - Loss of up to 73% of the antibody repertoire
 - Alters lymphoproliferative and cytokine responses
 - Effects can last up to 5 years after the infection
 - 50% of childhood deaths of any cause (especially infection related) occur within 2 months of measles infection
 - In addition to the 1-3/1000 expected as a direct result of measles disease

Measles Transmission

- Contagious 4 days before onset of rash to 4 days after
 - Most contagious during the prodromal phase when measles often isn't suspected
- Airborne transmission
 - Droplet nuclei can remain up to 2 hours in the air
 - 90% attack rate
- Usually a childhood illness since infection caused lifelong immunity
 - Everyone would get it eventually
 - Assumed to be immune if born before 1957
 - Exception if you are a healthcare worker

Measles Disease

- The Health Department is your friend
 - Diagnosis
 - PCR of NP swab, urine
 - Serology (commercial lab)
 - Isolation and contact tracing
 - In facility: Airborne precautions, mask at door, keep away from public areas until 4d after onset of rash
 - Home: follow health dept recs
 - Incubation period of 21 days for exposed
 - Don't forget to let facility Infection Prevention know (if you have IP support)

Measles Disease

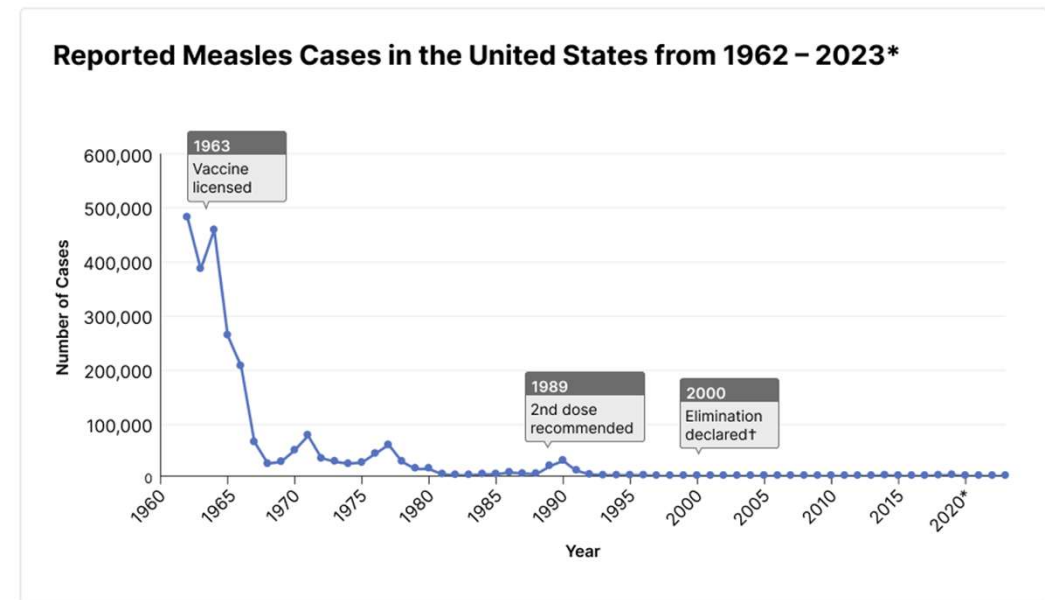
- Treatment
 - Supportive care
 - No antiviral available
 - If they aren't sick enough for hospitalization, keep them out of the hospital
 - Vitamin A
 - Can be helpful in severe disease, ocular disease, Vit A deficiency
 - Cochrane review: not helpful for the most part
 - Didn't improve mortality, pneumonia, diarrhea

Combating Measles

- Vitamin A doesn't prevent measles
 - May be benefit in Vitamin A deficient patients
- Clarithromycin doesn't treat it
- Measles still circulates, kills and maims despite modern sanitation and improved nutrition
- Post exposure prophylaxis with immune globulin is somewhat helpful
- Our only really effective tool is vaccination

Measles Vaccine

- Ineffective killed vaccine 1963-1967
- Live attenuated vaccine introduced 1968
 - 1st dose 93% effective
 - 2nd dose 97% effective
 - Decreased all cause mortality in countries linked to timing of introduction of measles vaccine
- Measles declared eliminated in the US in the year 2000
- Estimated to have saved 94 million lives worldwide



Measles Vaccine

- Contraindicated
 - Immune compromised
 - Pregnant patients
 - Allergic to vaccine component
- Many, many studies show no link to autism
- Typical, expected side effects
 - Pain, swelling, fever, etc
 - Can get a fever/rash 1-2 weeks later
- Rare side effects:
 - ITP: 1 in 40,000 (1 in 20,000 risk from measles infection)
 - Febrile seizures (1 in 4000, 1 in 2600 with 1st dose MMRV combo)

Measles Vaccine Schedule

- 1st dose: 12 months of age
- 2nd dose: 4 years of age
 - Can give as soon as 28 days after the 1st dose in higher risk situations
- Special situations: 6-11 months of age
 - Exposure
 - Planned travel to endemic area
 - Ongoing outbreak in the area
 - Currently Mohave County and Maricopa County
 - Stay tuned
 - Maternal antibody interferes with efficacy so doesn't count towards the 2 dose series

What Happens When You Stop Vaccinating: the Samoa Experience 2019

- 198,000 people on 4 islands
 - Decreased medical resources and declining vaccine rate over years
- 2 nurses prepared MMR vaccine with paralytic (atracurium) instead of water
 - 2 children died
- Anti vaccine messaging groups pounced
- Vaccine rate dropped to 31% in some communities
- 5707 people infected with measles over 3 month period
 - 83 died, almost all were unvaccinated children
- Attitudes changed, increased vaccination rate to 95%
 - Disease transmission eliminated
 - No more deaths (including no one dying from the vaccination!)

2008 Tucson Measles Outbreak

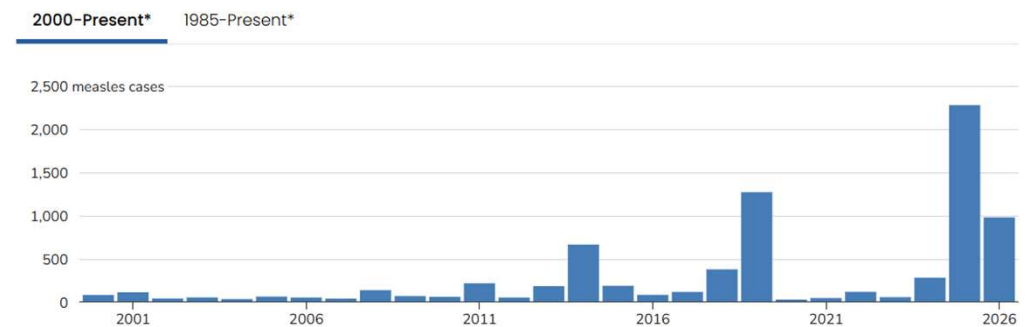
- Traveler from Switzerland developed classic signs/symptoms of measles
 - Visited multiple healthcare facilities and multiple public places before it was recognized
 - Patient 1 exposed 1700 patients, 1757 HCP, 145 airline passengers, 3 household contacts
- 14 confirmed cases over a 13 week period (additional 363 suspected, 8 probable)
- Some patients that developed measles were only in the same waiting area. 2 cases only in the same hospital

What's Happening in the US Now?

- Many people choose not to vaccinate
- 2025: 48 outbreaks!
 - 2287 cases
 - 93% unvaccinated patients
 - 3 deaths
- 2026 (as of May 28)
 - 1983 confirmed cases
 - 92% unvaccinated

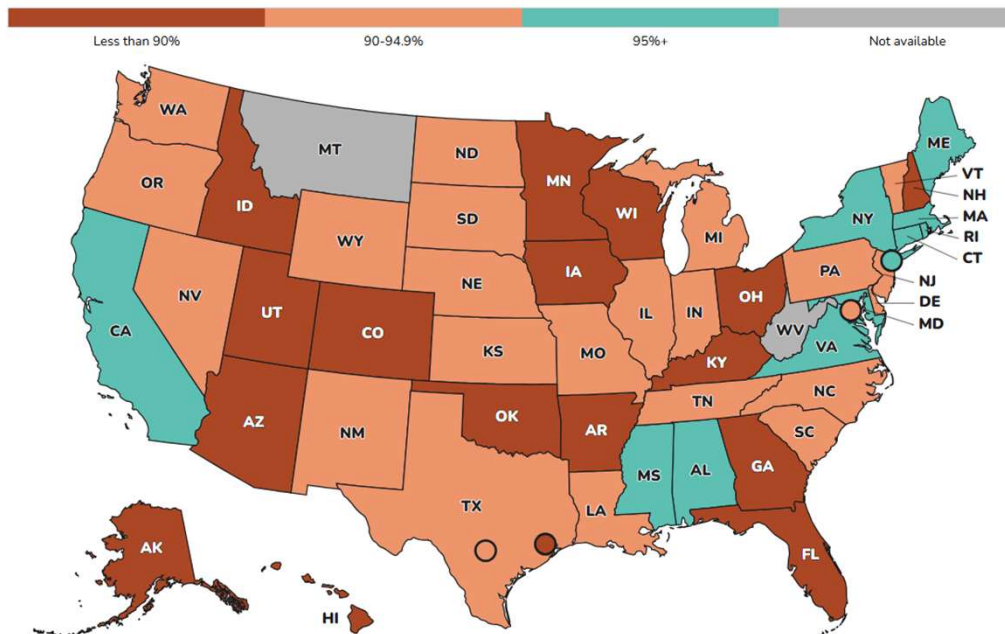
Yearly measles cases

as of February 19, 2026



What's Happening in the US Now?

Percent Vaccinated



<https://www.cdc.gov/measles/data-research/index.html>, <https://www.aap.org/en/patient-care/immunizations/immunizations-across-america/>

Measles in Arizona

- 86.5% of children have at least 1 dose of MMR in AZ
 - Has been dropping by about 0.5% per year for the last few years
 - Need 95% coverage to prevent outbreaks
- 2026: 317 measles cases, 96% unvaccinated, 67% <18y/o, 25 hospitalizations
- Mohave county experience 2025-2026
 - 1 elementary school: only 7% of students had both doses of MMR
 - 2nd elementary school: only 40% had 2 doses of MMR
 - Pertussis was already circulating in the same community
 - Many won't talk to the health dept, follow up, follow quarantine recommendations, get tested, etc
 - "Just a cold" "It's the new scare tactic"
- Recent local transmission in Maricopa county

What To Do if Exposed To Measles?

- Immune (vaccinated, serology, age in certain situations):
 - No intervention, watch for breakthrough symptoms for 21 days
 - Exception: immune compromised
 - PEP regardless of prior immunity
- Non-immune:
 - Vaccinate within 3 days if not contraindicated
 - Can give as young as 6m of age (doesn't count towards 2 dose series)
 - Contraindicated for vaccine: immune globulin within 6 days

Recent Case

- 6 y/o boy, fully immunized, fever x2 days, rash all over the body x1 day. Rash started on abdomen and spread over the course of the day and includes palms. No cough, coryza or conjunctivitis. Looks well appearing otherwise and is smiling.
- Measles?
 - What should you do?
 - Mask the patient (simple mask), isolate (airborne if possible), get out of the waiting room
 - Wear N95
- Ended up being Erythema Multiforme



Mimics

- Morbiliform (literally measles-like) rash
 - Kawasaki
 - Scarlet Fever
 - Drug Rash
 - Erythema Multiforme
 - Other viruses: adenovirus, HHV-6, Enterovirus, Parvovirus, Dengue, Rubella
- It is OK to isolate for non measles false alarms!!!



HHV-6



EBV with rash after amox

Coming Soon to a Clinic Near You!

- <https://youtube.com/shorts/31tnXPlhA7w?si=WwFPvZkkAQZEHNro>
- <https://www.youtube.com/watch?v=S3oZrMGDMMw>

Whooping Cough

- *Bordetella pertussis*: Gram negative bacteria
- Incubation period of 5-21 days
- Droplet transmission
 - Vaccine is effective, but you can still get it even if you have been vaccinated
 - Post exposure prophylaxis recs for close contacts
- Infections occur year round

Pertussis: The 100 Days Cough

- 3 stages
 - Catarrhal
 - Lasts 1-2 weeks: runny nose, lacrimation, mild cough
 - Looks like common cold
 - Paroxysmal
 - Lasts 1-6 weeks
 - Spasms of coughing, may have the whooping intake of breath
 - Can have post tussive emesis
 - Convalescent
 - Lasts weeks to months

Pertussis: Clinical Findings

- Usually afebrile
- Young children often don't have the characteristic whoop
- Often have lymphocytic leukocytosis
 - 15k-100k
- Chest exam usually normal, but CXR can show perihilar opacity and interstitial edema
 - Fever and lobar infiltrate: think bacterial superinfection
- Many cases asymptomatic or mildly symptomatic

Pertussis

- Diagnosis
 - NP swab PCR: most reliable in the first few weeks of infection
 - Serology: interpretation can be complicated by vaccination
- Treatment
 - May ameliorate symptoms if started early
 - Erythromycin, azithromycin, trim/sulfa
 - Can decrease length of contagiousness
 - Can d/c droplet precautions/isolation after 5 days of rx
- Young infants should be closely evaluated
 - Need to witness and assess severity of paroxysms
 - Most infants <3 months of age are hospitalized to assess progression of disease

Pertussis Complications

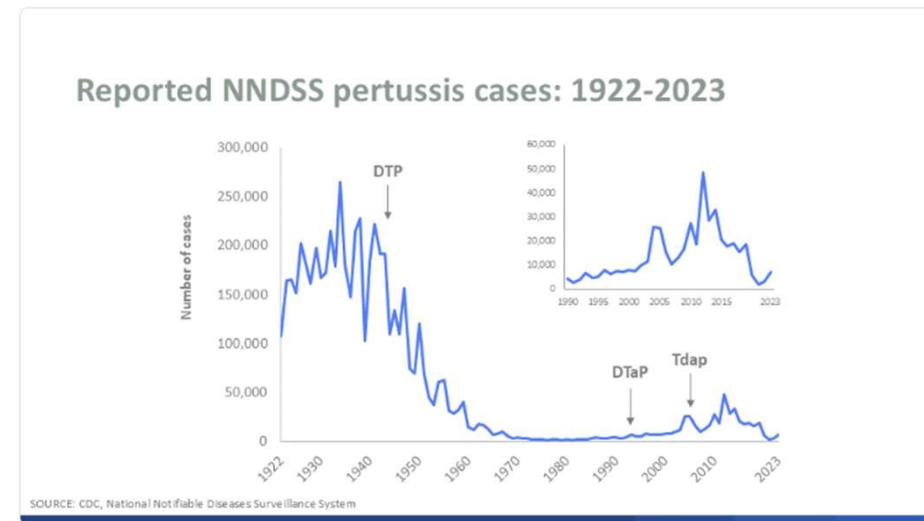
- Apnea and death in young infants
 - Like RSV apnea can occur in absence of severe cough. But can also occur with severe cough
- High pressure problems
 - CNS bleeds
 - Pulm hypertension
 - Rectal prolapse
- Diaphragm rupture
- Broken ribs
- Encephalitis, seizures
- Long term intellectual impairment

Pertussis

- Contagious
 - Up to 3 weeks after onset of cough
 - 80% household contact attack rate
 - Can stop isolation after 5 days of antibiotics
- Most infants infected by a family member
- Immunity from infection (and vaccination) may wane over time
- Vaccine efficacy
 - 70-90% DTaP and Tdap
 - 95-98% maternal vaccination during pregnancy for protecting the infant

Pertussis Vaccination

- Decreased incidence by 93% after widespread use of vaccine
- Whole cell vaccine had increased reactogenicity, has been replaced by acellular vaccine
- DTaP
 - Childhood vaccine schedule <7y of age
- Tdap
 - Added after recognizing that immunity was waning in adolescents/young adults
- Every pregnancy
 - Cocoon theory and evidence of efficacy



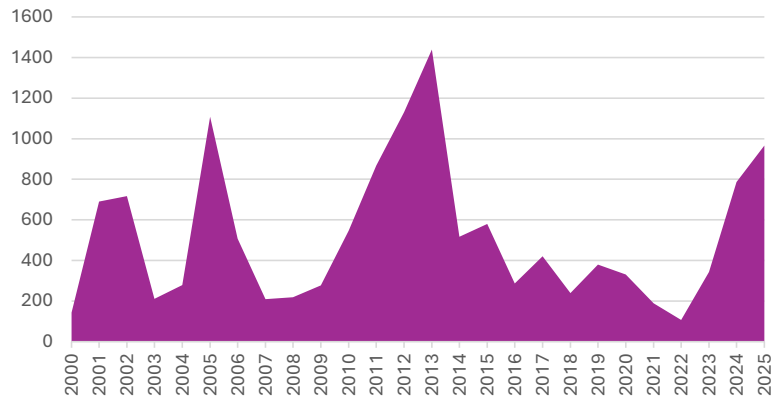
Pertussis Vaccine

- Adverse effects
 - Whole limb swelling
 - Not a contraindication to subsequent vaccination
 - Brachial neuritis?
 - Hypotonic hyporesponsive syndrome
 - Less likely with acellular, not a contraindication
- Contraindications
 - Encephalopathy within 7 days of vaccination
 - Anaphylaxis to vaccine component
- Precautions
 - Guillain-Barré within 6 weeks of vaccination
 - Moderate/severe acute illness
 - Evolving neurologic disorder
 - Avoid confusion with possible adverse effect of vaccine

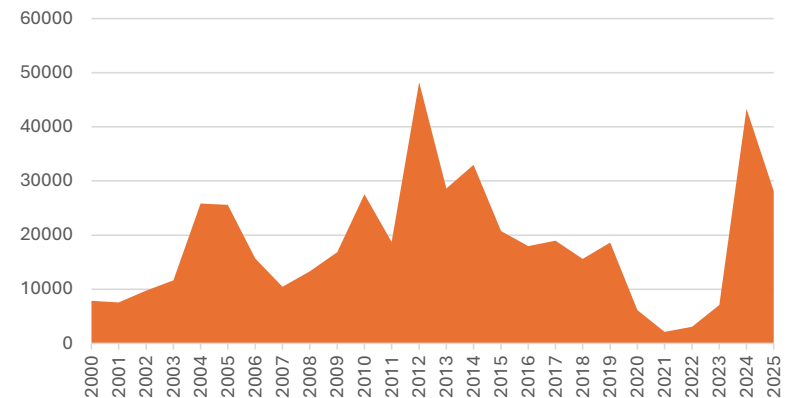
Pertussis Trends in the US and AZ

- 200-260k infections annually in the pre-vaccine era
 - 2024: 43k infections (787 in AZ), 10 deaths nationwide (6 were <1y/o)
 - 2025: 28k infections (967 in AZ), At least 5 deaths

Arizona Pertussis Cases 2000-2025



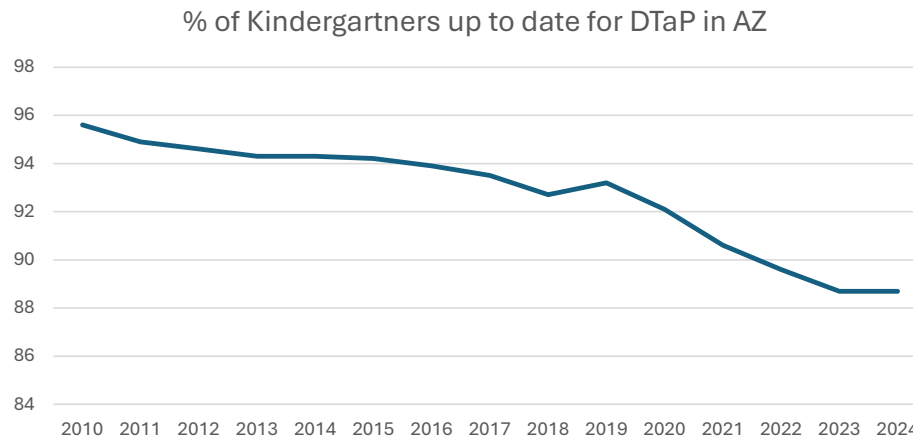
US Pertussis Cases 2000-2025



<https://stacks.cdc.gov/view/cdc/251274>

Arizona Pertussis Vaccine Coverage

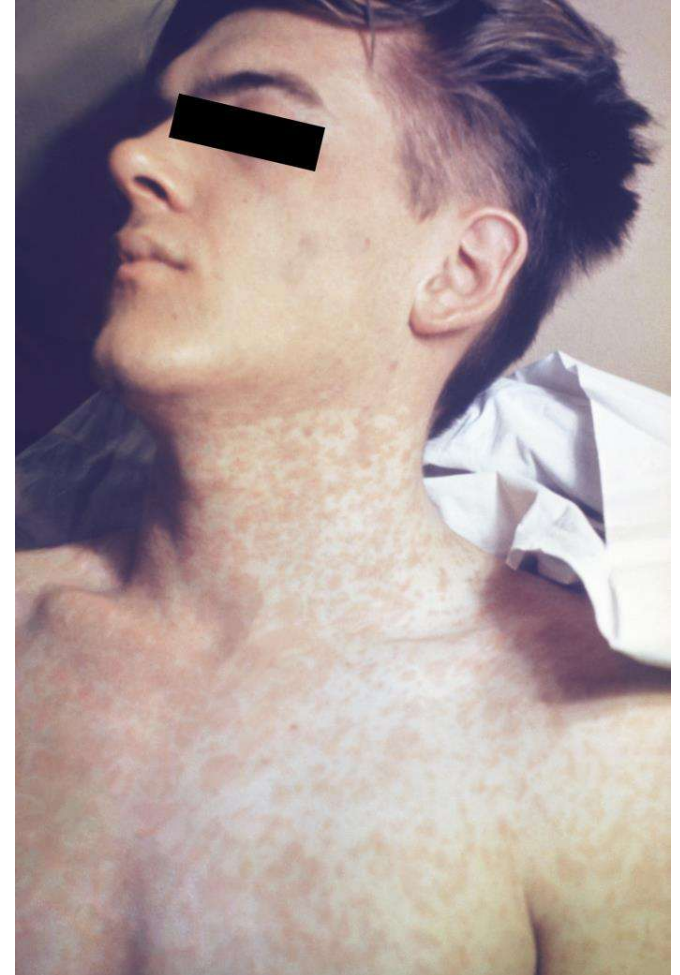
- Need 90-95% to prevent outbreaks
 - 2024 AZ kindergartners
 - 88.7% overall
 - 76.8% in Yavapai county



<https://apps.azdhs.gov/IDRREportStats>

Clinical Case

- Young adult male with 2 days of temp to 100.5, then rash on head, spreads to trunk, fades in a few days. Otherwise does fine.
- What is this?
 - Rubella
 - Epidemics every 6-9 years
 - 50% of infections are subclinical
- Why do we care?
 - 1 in 6000 get encephalitis
 - 1 in 3000 get thrombocytopenic purpura
 - 70% of women get transient arthritis



Congenital Rubella Syndrome

- 1962-1965 worldwide pandemic
 - 12.5 millions cases in the US
 - 20,000 congenital cases
 - 11,250 fetal deaths, 2,100 neonatal deaths
 - 2000 cases of encephalitis
 - 3580 hearing or sight disabilities
 - 1800 with developmental delays
- 2017 India: serosurvey estimated 1 in 5 women of reproductive age susceptible to Rubella
 - Estimate up to 50,000 cases of congenital rubella per year



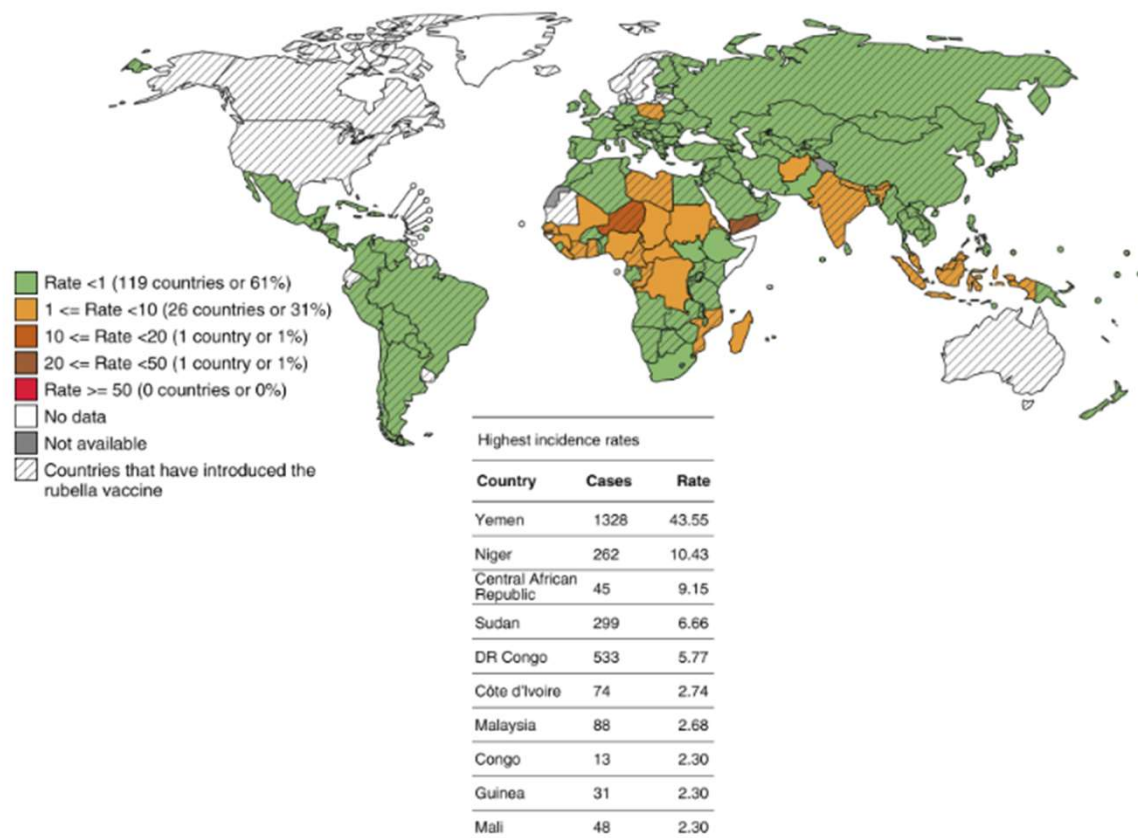


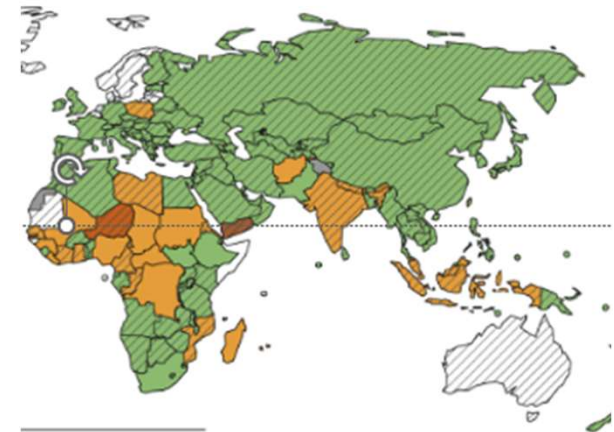
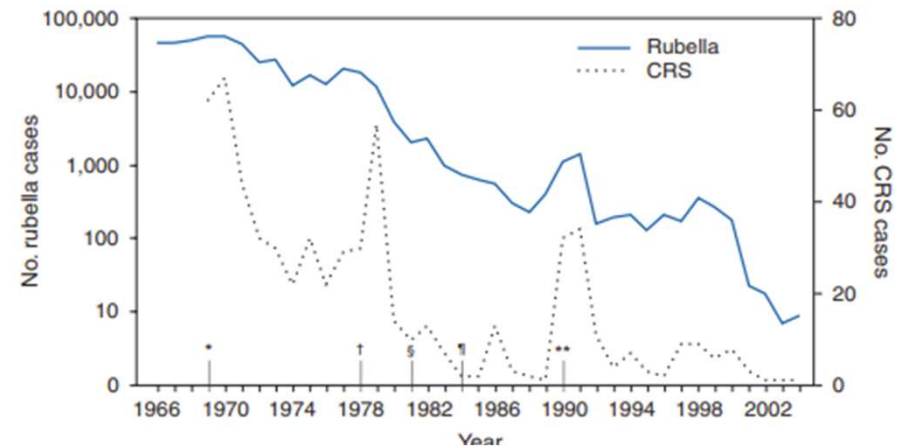
FIG. 159.2

The World Health Organization map of rubella prevalence in reporting countries as of April 2022. Map lines delineate study areas and do not necessarily depict accepted national boundaries.

Rubella Vaccine

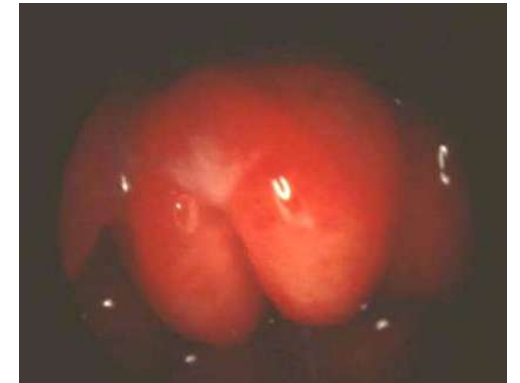
- Part of the MMR vaccine
- Single dose 97% effective
- Declared eliminated in the US in 2004
- Need 95% coverage to prevent outbreaks
 - AZ MMR rate: 86.5% and dropping
 - One school 7%

FIGURE. Number of reported cases of rubella and congenital rubella syndrome (CRS), by year, and chronology of rubella vaccination recommendations by the Advisory Committee on Immunization Practices — United States, 1966–2004



And the List Goes On

- Mumps: parotitis
 - Orchitis and infertility
- Tetanus
 - 20% mortality in the modern era
 - Ubiquitous spores
- Hib
 - Meningitis, MSK infections, epiglottitis, sepsis
 - 20,000 cases, 1000 deaths per year before vaccines
 - Up to 30% of meningitis survivors had hearing or neurologic sequelae
- Meningococcus
 - Sepsis and meningitis



Vaccine Fears Aren't New



An 1802 engraving, *The Cow Pock—or—the Wonderful Effects of the New Inoculation* plays on the fears of a crowd of vaccinees. ©The Trustees of the British Museum

How Do We Know Vaccines are Safe?

- False assumption by many that vaccines are inherently dangerous
- Robust system in place to test vaccines before and after bringing to market

How are vaccines developed and brought safely to market?

- Preclinical studies
 - Cell cultures and other in vitro studies
 - Animal studies
- Clinical trials: Phases I-III (and sometimes IV)
 - Phase I: very small group, usually healthy volunteers, dosing ranges, focuses on safety
 - Phase II: often larger group of healthy volunteers, focuses on safety and efficacy
 - Phase III: larger group, target population, focuses on safety and efficacy

Approval process: the way it used to be

- FDA
 - Evaluation of all the data
 - If safe and effective would move to the next step
 - Labeling, prescribing, storage info, etc
 - Usually a post approval surveillance plan
- ACIP
 - Used to be many qualified members with varied extensive experience, mitigated conflict of interest risks
 - Evaluate the data
 - Make recommendations of who should be vaccinated and what schedule
- CDC would adopt the recommendations and publish them

Vaccine Safety: Post Approval

- Phase IV trials
- VAERS
- V-safe
- Sentinel BEST (Biologics Effectiveness and Safety) system
- CMS
- Vaccine Safety Datalink
- ACIP

Example: COVID Vaccines

- Rapid progression through all the steps
 - Spent lots of money hoping it would progress to the next step, many didn't
- Tens of thousands of participants in adult trials (including placebo)
- Thousands of participants in pediatric trials (including placebo)
- Millions of patients followed in post marketing studies
- Ongoing data collection around the world

Failures and Unanticipated Problems

- 1/230 early rabies vaccine recipients in the 1800s developed seizures, paralysis, coma
- 1940s sera unknowingly infected with Hep B given to stabilize military recipients of yellow fever vaccine. 330,000 infected with hep B, severe disease in 50,000, 62 died
- 1955 one company failed to completely inactivate polio strain, injecting 120,000 with live poliovirus. 40,000 developed mild polio, 200 permanently paralyzed, 10 died
- Increased mortality due to RSV in early RSV vaccine candidate trial in the 1960s

Failures and Unanticipated Problems

- Small risk of paralytic polio after oral polio vaccine
- Guillain-Barré associated with 1976 swine flu vaccine
 - 45 million people vaccinated in 10 weeks in the US
 - Likely 1 case of Guillain-Barré per 100,000 vaccinated, caused 53 deaths
 - Current flu vaccines: higher risk of Guillain-Barré after influenza infection compared to after vaccination
- Intussusception associated with original rotavirus vaccine- detected by VAERS and vaccine removed from market. Subsequent rotavirus vaccines have extensive evaluation for intussusception pre and post approval

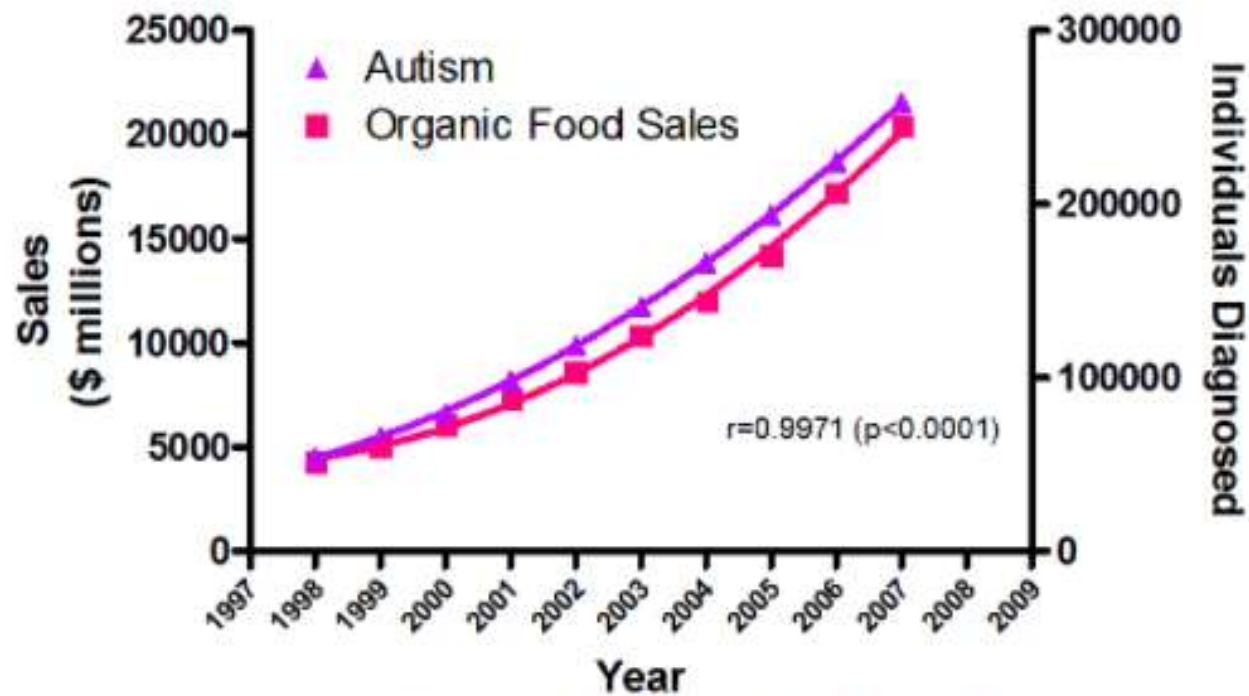
Potential Problems

- Known
 - BCG vaccine in immune compromised patients
 - Smallpox vaccine and patients with eczema
 - Live virus vaccines and immune compromised patients
 - Yellow fever vaccine reaction and older adults
 - Anaphylaxis
- Unknown
 - Yet to be discovered rare events
 - Systems in place to mitigate the risks

Association, Correlation, Causation or Error: Potential for Parm

- 1970s: 22 cases of permanent brain damage in children that got whole cell pertussis vaccine.
 - Vaccination rate in Britain decreased from 81% to 31%
 - 100,000 cases of pertussis with 36 deaths.
 - Many studies later: no association difference in rates of intellectual disability or epilepsy in vaccinated children compared to controls
- Deaths after DTwP vaccination, HPV vaccination, Hep B vaccination in various countries led to suspension of vaccination.
 - Later found to be unrelated to the vaccine.

Association $\neq$ Causation



Sources: Organic Trade Association, 2011 Organic Industry Survey; U.S. Department of Education, Office of Special Education Programs, Data Analysis System (DANS), OMB# 1820-0043: "Children with Disabilities Receiving Special Education Under Part B of the Individuals with Disabilities Education Act"

Autism: Vaccine Fear in the Modern Era

- Autism is terrible disease that has no cure, cases are increasing
 - Symptoms often are recognized around 1 year of age
 - MMR is given at 1 year of age
 - Natural to suspect a link between the two
- 1998: Andrew Wakefield published a case series of 12 children with autism-like symptoms and chronic GI problems in Lancet
 - Asserted that all developed symptoms after MMR
 - Asserted that all had GI abnormalities on endoscopy (didn't look for the virus)
 - Posed theory that MMR (not the separate measles vaccine) caused GI disturbances
 - Recommended single dose measles vaccine

Problems

- Can you really make any conclusions based on 12 patients?
- No one, including Wakefield can replicate the results
- Wakefield was being paid by an attorney suing the MMR vaccine maker
- Wakefield had a patent for single component measles vaccine
 - Remember that he said it was the MMR and not the single component measles vaccine that was the problem
- Investigative reporter finds out that some of the patients had symptoms prior to the MMR vaccine, some had no abnormality on biopsy
- Almost every patient had a significant discrepancy affecting the ability to interpret the results

Post Wakefield Lancet Paper

- Lancet retracted the article
- At least 14 studies involving millions of children and many countries that show no link between autism and MMR
 - Including Denmark
- Scare continues because the emotion of fear due the possibility based on 12 mis-represented patients can't be overcome for many people despite experience of millions of patients that refute it

The Simple Facts About Vaccines

- They work very well
 - Nothing is perfect
- They are extremely safe
 - Nothing is perfect
- They are timed to give the most protection at the right time
 - Alternative schedules put children at risk with no benefit
- Our job is much more complicated because many people don't trust that the above statements are true
 - We have to work with them so they can gain our trust and protect themselves and their children
 - Some hate the phrase "safe and effective"
 - Many will not be convinced, some will suffer grave consequences
- Many arguments against vaccines sound scary and legitimate at first glance

Myth: We Know That Vaccines Are Dangerous Because We Have A Fund To Pay For Damages

- National Vaccine Injury Compensation Program (VICP)
 - No fault program to compensate patients adversely affected by vaccines
 - Funded by excise tax on all vaccines
 - Determined based on vaccine, type of injury and timing of injury
 - Legal process, not a medical process
 - Tend to err on the side of the affected patient
 - Info on the VICP is on the VIS form for every vaccine
- Protects vaccine makers that are doing things in good faith and following good practices
 - Otherwise we wouldn't have vaccines
- There to help in case of rare adverse effect

Myth: Vaccines Aren't Safe Because They Didn't Do A Placebo-Controlled Trial

- Even the public now knows that the gold standard in science involves a randomized, double-blind, placebo-controlled trial

RESEARCH

 OPEN ACCESS

 Check for updates

Parachute use to prevent death and major trauma when jumping from aircraft: randomized controlled trial

Robert W Yeh,¹ Linda R Valsdottir,¹ Michael W Yeh,² Changyu Shen,¹ Daniel B Kramer,¹ Jordan B Strom,¹ Eric A Secemsky,¹ Joanne L Healy,¹ Robert M Domeier,³ Dhruv S Kazi,¹ Brahmajee K Nallamothu⁴ On behalf of the PARACHUTE Investigators



The Placebo Question

- Most vaccines have been developed using a placebo-controlled trial of some type
- It may not be safe/ethical to withhold a vaccine to do a placebo-controlled trial
 - Known deaths from the disease and known prior vaccine that was safe
 - Each iteration of flu vaccine doesn't need a trial
- Other safe ways to control for variables in a trial

The Fear Of Death From Vaccines

- COVID Vaccine
 - 2023 Rasmussen Survey
 - 1100 adults
 - Men and women, variety of minorities included
 - 47% said they know someone who died from COVID infection
 - 24% said they know someone who died from the COVID vaccine!!!
 - Same for Democrats and Republicans surveyed
 - Government employees 40%
 - Interpret with caution: some fears are exacerbated by knowing others are scared about something, even if that fear is unfounded

What Do the Data Tell Us About COVID Vaccine Related Deaths?

- 2021 European data
 - 377 **million** doses administered of the 4 major COVID vaccines
 - 5,201 deaths temporally related to vaccination
 - Unable to confirm, make a strong connection to vaccination and death in the majority of cases
 - Real possibility for some: blood clots, etc
 - Background of 3.8 million deaths worldwide by that time
- Oregon Study: sudden cardiac death after COVID vaccine 2021-2022
 - 1292 all cause deaths in 16-30 year olds
 - 30 died from COVID-19 disease
 - 3 deaths within 100 days of COVID vaccine, none able to be attributed to vaccination, but 1 without underlying medical conditions

COVID Vaccine Related Deaths?

- England study:
 - Evaluated risk of death in 12-20 y/o from 2020-2022
 - COVID infection
 - COVID vaccination
 - 12 weeks immediately following vaccination vs >12 weeks after vaccination
 - Findings
 - Vaccinated group: same mortality rate 12wks vs > 12 weeks
 - Unvaccinated group: higher mortality rate compared to vaccinated group

What Do The Data Show About General Vaccine Related Deaths?

- 2013 study: VSD data evaluated from 2005-2008
 - 13 million vaccinated people
 - Mortality rate in **unvaccinated** people was almost **2x higher** than vaccinated people
- Anaphylaxis
 - Estimated 2 cases per million doses
 - Doesn't guarantee death
 - Questions about prior history
 - Healthcare providers should be prepared to manage anaphylaxis

What Do The Data Show About Vaccine Related Deaths?

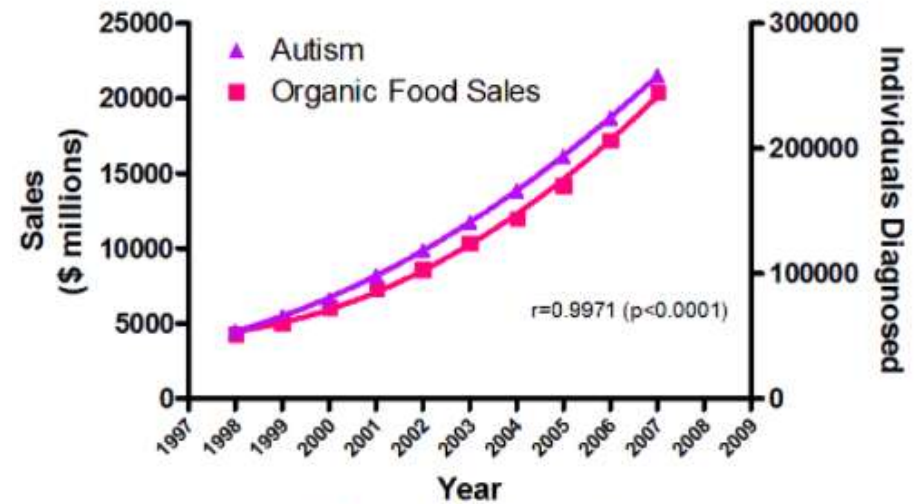
- Yellow fever vaccine associated viscerotropic and neurologic disease
 - 35 reported deaths in adults
 - Vaccine administrators need to be certified, and patients informed of risk
- Oral poliovirus vaccine (no longer used in the US)
 - Risk of disease: 1 in 4.7 million, death is rare
 - 2 deaths in the US from 1980-1989

What Do VAERS Data Show About Vaccine Related Deaths?

- Many deaths attributed to SIDS
 - Additional studies show that no increased rate of SIDS in vaccinated infants compared to unvaccinated infants
- Immune compromised and live virus
 - Case reports per 2015 review
 - 2 VZV, 6 measles
 - Live virus vaccines contraindicated in immune compromised patients
- Intussusception and rotavirus 2006-2012
 - 2 deaths reported, unable to establish causality
- H1N1 influenza vaccine and Guillain-Barré 2000-2009
 - 2 deaths within 6 months of vaccination, unable to establish causality
- Syncope and head trauma leading to death: 1 case after Hep B vaccination

Vaccine Deaths

- The data don't support the belief that death or serious adverse events occur commonly with a vaccine
- 40 years of experience between my colleagues and I
 - Know of no deaths from a vaccine in our patients or their families
 - Have seen about 20 children die from flu
 - Handful of deaths from meningococcus



Sources: Organic Trade Association, 2011 Organic Industry Survey; U.S. Department of Education, Office of Special Education Programs, Data Analysis System (DANS), OMB# 1820-0043; "Children with Disabilities Receiving Special Education Under Part B of the Individuals with Disabilities Education Act"

Myth: Vaccines Will Overwhelm the Immune System

- We sometimes set ourselves up for this with infants
 - Their immune systems aren't fully developed
 - Polysaccharide vaccines don't work under age 2
 - B-cells at that age don't recognize polysaccharide antigens very well
 - Susceptible to bacteria that have polysaccharide capsules (Hib)
 - Some lymphoid tissue still developing
 - Newborns especially are at higher risk for severe infection
 - In our zeal to emphasize need for evaluation of symptoms in this age group we may scare parents about vaccines
- Good news: vaccines help the developing system to give extra protection without harming/overwhelming the immune system
- We don't have an epidemic of infant deaths from vaccines

Vaccines Can't Overwhelm the Immune System

- “Worrying about too many vaccines is like worrying about a thimble of water getting you wet when you are swimming in an ocean”
 - Dr. Crislip and Dr. Barrett
- We encounter millions of antigens per day
 - 25-50 from strep throat alone
- The immune system could theoretically handle 100,000 vaccines at once based on B-cell and T-cell repertoire

What Does Overwhelm the Immune System?

- Sepsis
 - Strep pneumo, Neisseria meningitidis
- Dysregulated immune response
 - Macrophage activation syndrome
 - DIC
 - Other poorly understood mechanisms
- Even flu and chickenpox can lead to overwhelming the immune system with collateral damage (ie death)

Myth: We Have Too Many Vaccines

- More vaccines, but fewer antigens
 - Decreased from ~3000ag to ~200ag
 - But wouldn't overwhelm the immune system anyway
 - More protection is better: our children have more ways to avoid suffering
- Autoimmunity
 - Studies found no link between vaccines and lupus, MS and other diseases
- Asthma
 - No link between vaccines and asthma
 - Vaccines can prevent viral illness that can cause asthma exacerbation

Vaccine Confusion And Infant Hep B: ACIP

- Background: ACIP recently recommended
 - Among women who **screen negative in pregnancy**, parents decide, in consultation with providers, when or if to vaccinate their child for hepatitis B, and if not at birth, then no earlier than 2 months of age
 - Consider collection of infant immune titers to guide decision-making for completing the vaccine series.
- Some basic ACIP assumptions underlying this recommendation
 - There is danger in the birth dose of vaccine
 - Wrong!!!
 - There is no risk of Hepatitis B if mom has a negative test
 - Wrong!!!
 - Serology can determine if immunity is adequate
 - We'll talk about it

Prepublication Release

PEDIATRICS

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Hepatitis B Vaccination at Birth: Safety, Effectiveness, and Public Health Benefit

Angela K. Ulrich, PhD, MPH, Derek F. Fleming, PhD, Emily A. Smith, PhD, MPH, Cory J. Anderson, PhD, MPH, Angela J. Mehr, MPH, Sydney G. Redepenning, PhD, MS, Clare J. Stoddart, MS, Leah E. Moat, MPH, Rochelle P. Walensky, MD, MPH, Eve M. Lackritz, MD

<https://publications.aap.org/pediatrics/article/doi/10.1542/peds.2025-075783/206357/Hepatitis-B-Vaccination-at-Birth-Safety?autologincheck=redirected>

Some More Background On Hep B

- 90% of babies that get Hep B develop chronic infection
 - For the most part incurable
 - 25% of these will die young
 - Hepatocellular carcinoma, cirrhosis, liver transplant
- There is up to 3% false negative test rate
 - Low numbers are still a problem in universal screening
- 50% of children with Hep B were not found by prenatal screening
- 20% of children with Hep B had no positive household members
- Immunization options
 - Active immunization: vaccination with the Hep B series
 - Passive immunization: Hep B immune globulin when mom is positive

Birth Dose Of Hep B

- Fragile babies
 - 40 years of US/world experience giving Hep B vaccine shows it is safe and effective
 - Studies show no increased risk of adverse effects from the birth dose
- Immune system works
 - Protein based vaccine: B-cells and T-cells work together
 - Make protective antibody
 - Memory B-cells and memory T-cells for long lasting immune recognition and cooperation
 - Bolsters the fragile baby and protects from a disease that really has no cure
- Give the protection at the time and place that makes the most sense
 - Can't 100% rely on maternal screening,
 - Potential lifelong infection, high rate of death and complications
 - Makes the most sense to give the vaccine as soon as possible
 - Vaccine series with the birth dose (and HBIG when needed) has decreased incidence of Hep B by 99%

Hep B Vaccine: Measuring Serologic Response?

- Vaccination produces neutralizing antibodies that can be measured
 - Higher titer of antibody with Hep B correlates with better protection
 - Booster doses restimulate the immune system to produce antibodies
 - Increases the titer
 - Not everyone has measurable titers with 1 or 2 doses
 - 1 dose: 25%, 2 doses 63%, 3 doses: 95%
 - Thus the series recommendation
- We don't know if a single dose with titer positivity is good enough
 - Is the titer high enough to be protective?
 - Will it be long lasting?
 - Not sure why ACIP recommended it

Myth: Natural Immunity is Better Than Vaccine Induced Immunity

- What is your definition of better?
 - Longer lasting?
 - Less risk?
 - More effective one way or another?
- False assumption that vaccines are inherently dangerous
- Vaccine immunity may not last as long
 - We have boosters for that
- Not all diseases confer immunity
 - Flu, COVID: rapidly changing
 - Tetanus and diphtheria: toxin has such high potency, still need vaccination if you survive
 - Hep B, HPV: establish chronic infection and don't get immunity

Natural Immunity Is NOT Preferable

- Not all vaccine preventable illness confer immunity
- Have to get the disease first



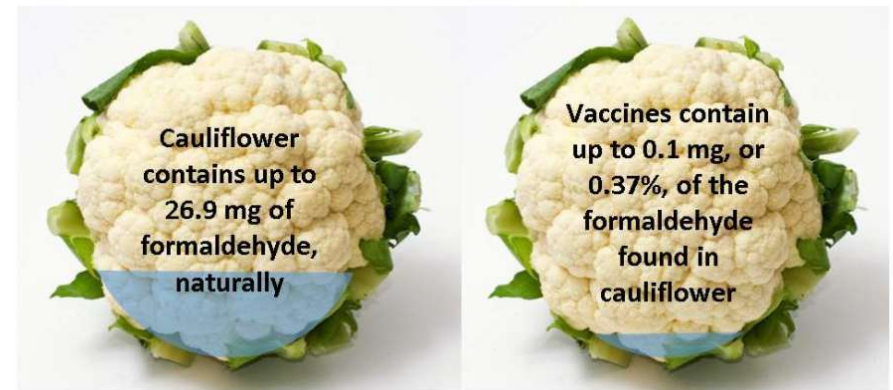
Myth: Vaccines Are Poisoning Our Children (And Us)

- Like many things can sound concerning at first glance
 - Formaldehyde
 - Aluminum
 - Thimerosal (mercury)
- Vaccine components are safe if you take a deeper look

Formaldehyde

- Inactivates viruses. Potential for trace amounts to be in vaccines
- Naturally occurs in the environment
- Found in car exhaust, cosmetics, carpet, felt tip markers, mouthwash
- Produced by metabolic pathways
 - 2.6mg/L in blood at steady state levels
 - Up to 0.1mg in a vaccine

Concerned about formaldehyde in vaccines?



Vaccine Ingredients Are Safe

- Thimerosal
 - Ethylmercury, different from the toxic methylmercury
 - Preservative in multidose vials to prevent bacteria/fungi from growing
 - Many studies showing no harm beyond possible allergic reaction and pain at injection site
 - Has been removed from most vaccines since 2001 due to unsubstantiated fear
 - Autism rates and other fears continue to climb
- Aluminum
 - Adjuvant to enhance immune response
 - Get more aluminum in every day life experience
 - 30-50mg/day (vaccines have 0.125-0.625mg/dose)

Myth: Polysorbate 80 In Vaccines Causes A Leaky Blood Brain Barrier And Brain Damage

- Polysorbate 80: stabilizer or residual vaccine manufacturing byproduct
- 1984 study in rats showed that 60,000mcg/kg dose injected into the carotid could increase permeability of the BBB
- Polysorbate in vaccines?
 - Most have <100mcg
 - 1 flu vaccine has 1750mcg
- Used as an emulsifier in food, vitamins, supplements and beauty products
 - ½ cup of ice cream has 170,000mcg of polysorbate 80

Myth: We Are Injecting People With Aborted Fetal Tissue

- MRC-5 and WI-38
 - cell lines originally derived from fetuses aborted for other reasons unrelated to the vaccine
 - While originally obtained from aborted fetuses, these cell lines are maintained without need for new fetal tissue
 - Original cells no longer exist
- Cells are removed from the viruses used to make the vaccine
 - Used to make varicella, rubella, hep A and one of the rabies vaccines
- 2005 Vatican released a document discussing the ethics of using these vaccines
 - Fetuses weren't aborted specifically to produce a vaccine
 - Ongoing abortions are not done to propagate the vaccine
 - People should encourage companies/governments to find an alternative method to create effective vaccines for these diseases
 - The burden of disease should not fall on the vulnerable/innocent
 - Using these vaccines does not support abortion

Myth: HPV Vaccine Increases Sexual Promiscuity

- No, it doesn't and Yes, they've done multiple studies on it
 - This isn't an anti STI vaccine, it's an anticancer vaccine
- 80% lifetime infection risk
 - 25% infected by age 19
 - 36,500 men and women get HPV related cancer each year in the US
 - Vaccination can prevent >90% of HPV related cancers
- Vaccine may be more immunogenic at a younger age
 - Makes sense to start vaccination at age 9 to optimize protection and efficacy

Myth: Vaccines Don't Work

- We discussed extensively at the beginning of the talk
- But what about vaccines that “don’t work well”
- Influenza vaccine:
 - 2022-2023 season efficacy of 30%: sounds terrible, why get it?
 - Estimated up to 41 million infections each year
 - 6300-52,000 deaths in the US each year
 - 187 children in 2022-2023 season, up to 123 this season
 - 288 in 2024-2025 season
 - Half had no underlying conditions and 89% weren’t vaccinated
 - The antiviral therapy doesn’t work well
 - Not great vaccine 30% efficacy
 - Can protect against severe disease even if you get the infection
 - Estimated to prevent 5.5 million infections, 71,000 hospitalizations, 4,300 deaths
 - Any tool is useful in the fight against influenza and other infections

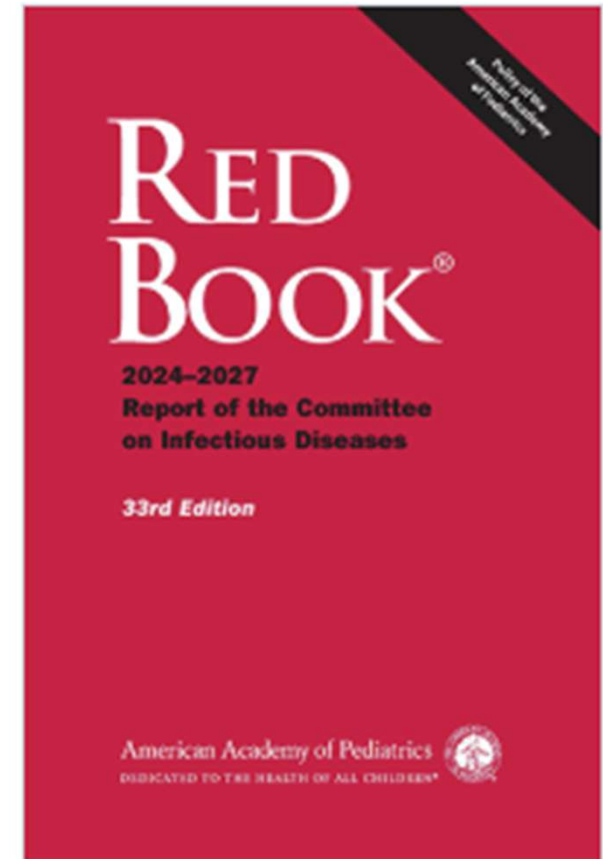


Where Do We Go From Here?

- Leverage the EHR and communication systems to maximize vaccine opportunities
 - Vaccines can be given at any visit
 - Reminders to patients
- Improve cooperation with systems for communicating vaccine status
- Most still get their information from a trusted healthcare provider
- Presumptive interviewing
- Addressing concerns
 - Motivational interviewing
 - Non-judgmental, open-ended questions
 - Establish trust
 - Recognize that many are not ready for change right now

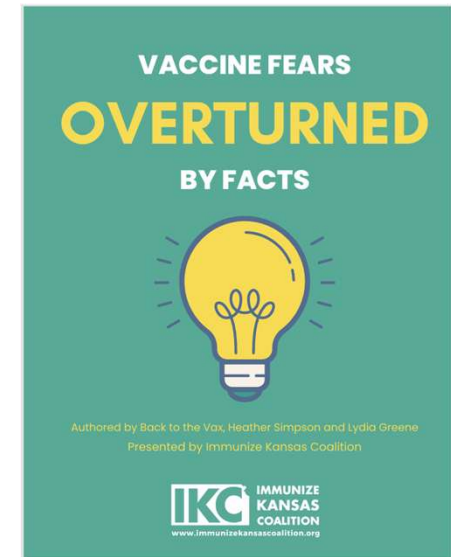
Resources for Vaccine Information

- AAP
 - Website resource for providers and families
 - Red Book
- AAFP
- AMA
- Children's Hospital of Philadelphia Vaccine Education Center
- Immunize.org
- University of Minnesota
 - Vaccine Integrity Project
 - CIDRAP
- Pre 2025 ACIP documents

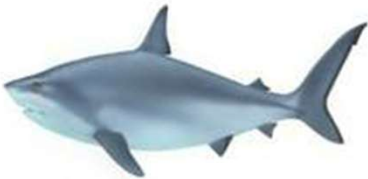


More Resources

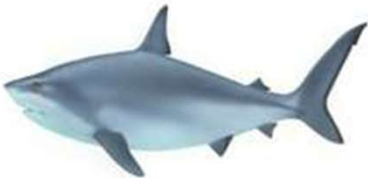
- [Immunizekansascoalition.org](http://immunizekansascoalition.org)
- Grandparentsforvaccines.org
 - “Heard Immunity”
- What the World’s religions teach, applied to vaccines and immune globulins. Vaccine 2013. Vol 31:2011-2023. Available at immunize.org
- AZDHS Annual Arizona Immunization Conference in the Spring in Mesa



Put Things in Perspective

What we ARE afraid of	What we SHOULD be afraid of
 28 attacks avg./year	 4,500,000 bites avg./year (46 deaths in 2020)
 50 deaths by peanut allergy avg./year	 27,531 deaths by poisoning avg./year
 321 deaths by plane crash avg./year	 34,017 deaths by car crash avg./year

Put Things in Perspective

What we ARE afraid of	What we SHOULD be afraid of
 28 attacks avg./year	 4,500,000 bites avg./year (46 deaths in 2020)
 50 deaths by peanut allergy avg./year	 27,531 deaths by poisoning avg./year
 321 deaths by plane crash avg./year	 34,017 deaths by car crash avg./year

Conclusion

- Many infections are rare because of the overwhelming success of vaccines
 - We are losing ground due to unfounded fears and rampant misinformation
- We can be the voice of reason and many will listen
 - Many are more receptive since the infections are circulating in or near our communities
 - Measles is no longer a theory and death isn't all that rare
 - Takes time and effort
 - Not everyone will change right now, but you can make a difference
- Keep up the good fight it will save lives

References

- AAP Red Book 2024-2027: Report of the Committee on Infectious Diseases, 33rd ed.
- Chen et al. Health care-associated measles outbreak in the United States after an importation: challenges and economic impact. *J Infect Dis*. 2011 Jun 1;203(11):1517-25
- Dittman et al. Successful control of epidemic diphtheria in the states of the Former Union of Soviet Socialist Republics: lessons learned. *J Infect Dis*. 2000 Feb;181 Suppl 1:S10-22
- Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 10th ed. 2026
- McLean et al. Prevention of measles, rubella, congenital rubella syndrome, and mumps, 2013: summary recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep*. 2013 Jun 14;62(RR-04):1-34.
- Mina et al. Long-term measles-induced immunomodulation increases overall childhood infectious disease mortality. *Science*. 2015 May 8;348(6235):694-9.
- Mina et al. Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens. *Science*. 2019 Nov 1;366(6465):599-606.

References

- MMWR 1973 Oct 13;22(41): 341-2. Epidemiologic Notes and Reports: Diphtheria on a Navajo Indian Reservation
- MMWR 1973 Nov 10;22(45): 379-380. Follow up on Diphtheria on a Navajo Indian Reservation
- MMWR 2005 Mar 25;54(11):279-82. Elimination of rubella and congenital rubella syndrome--United States, 1969-2004
- MMWR 2025 Sep 25;74(36):565-569. Influenza-Associated Pediatric Deaths - United States, 2024-25 Influenza Season
- Shanmugasundaram et al. Burden of congenital rubella syndrome (CRS) in India based on data from cross-sectional serosurveys, 2017 and 2019-20. PLoS Negl Trop Dis. 2021 Jul 23;15(7):e0009608
- WHO. Diphtheria Outbreaks. Comprehensive guidance for the public health preparedness and response in the WHO African Region. February 2024
- Vitek and Wharton. Diphtheria in the Former Soviet Union: Reemergence of a Pandemic Disease. Emerg Infect Dis. 1998 Oct-Dec;4(4):539-50